CLAIMS

1. An apparatus for providing and circulating to a medical device a medical gas mixture comprising at least two components, said apparatus comprising:-

a main gas circuit for recirculating the medical gas mixture and comprising:-

a constant speed circulation pump for pumping gas through the main circuit and increasing the gas pressure from a lower pressure to a higher pressure,

a pressure maintaining valve downstream of the pump and dividing the main circuit into a higher pressure section and a lower pressure section,

a medical gas outlet in the higher pressure section,

a spent gas inlet in the lower pressure section,

a first feed gas supply inlet ,

a second feed gas supply inlet downstream of the gas outlet and upstream of the pressure reduction valve,

concentration determining means for measuring the concentration of at least one component of the recirculating medical gas mixture and generating a signal indicative of said concentration,

circuit volume regulating means for varying the volume of the main circuit at a location in the lower pressure section for maintaining a predetermined gas flow to the pump and generating a signal indicative of said volume, and

means for venting gas from the main circuit;

a first feed gas supply conduit for supply to the first feed gas inlet of a first feed gas of predetermined composition;

first feed gas supply flow control means for controlling the flow of first feed gas through the first gas supply conduit in response to the signal from the

concentration determining means to maintain constant the medical gas composition at the pump inlet;

a second feed gas supply conduit for supply to the second feed gas inlet of a second feed gas of predetermined composition different from the first feed gas;

second feed gas supply flow control means for controlling the flow of second feed gas through the second gas supply conduit in response to the signal from the circuit volume regulating means to maintain constant the recirculating medical gas composition; and

a medical device supply circuit for connecting the medical device to the main circuit to receive a portion of the medical gas from the medical gas outlet thereof and to return spent gas to the spent gas inlet thereof and comprising:

flow control means for controlling flow of the medical gas to the medical device and

purification means for removing contaminant(s) from the spent gas.

2. An apparatus as claimed in Claim 1, wherein the feed gas supply inlets are located in the higher pressure section.

3. An apparatus as claimed in Claim 1 or Claim 2, wherein the pressure maintaining valve is a spill valve.

4. An apparatus as claimed in any one of the preceding claims, wherein the circuit volume regulating means comprises expansion bellows.

5. An apparatus as claimed in any one of the preceding claims, wherein the concentration determining means comprises a relatively high gain analog electrical circuit for the signal thereof and the circuit volume regulating means comprises a relatively low gain analog electrical circuit for the signal

thereof, whereby the increase in flow rate of the first feed gas is relatively quick and the increase in flow rate of the second feed gas is relatively slow.

6. An apparatus as claimed in any one of the preceding claims, wherein the concentration determining means measures at least oxygen concentration.

7. An apparatus as claimed in any one of the preceding claims, wherein the concentration determining means measures the concentration of at least two components and generates respective signals indicative of said concentrations and the apparatus further comprises:

a third feed gas supply inlet to the main gas circuit downstream of the gas outlet and upstream of the pressure reduction valve and upstream;

a third feed gas supply conduit for supply to the third feed gas inlet of a third feed gas of predetermined composition different from the first and second feed gases; and

third feed gas supply flow control means for controlling the flow of third feed gas through the third gas supply conduit in response to the respective signal from the concentration determining means to maintain constant the medical gas composition at the pump inlet.

8. An apparatus as claimed in Claim 7, wherein both the second and third feed gas supply flow control means are responsive to a signal from the concentration determining means and the signal from the circuit volume regulating means.

9. An apparatus as claimed in any one of the preceding claims, which further comprises an ultrasonic xenon analyser.

10. An apparatus as claimed in any one of the preceding claims, wherein the means for venting gas from the main circuit comprising a gas recovery space for storing at least a portion of the vented gas.

11. An apparatus as claimed in Claim 10, wherein the gas recovery space is an ullage space of a container providing one of the feed gases.

12. A medical device system comprising a medical device connected to the medical device supply circuit of an apparatus as defined in any one of the preceding claims.

13. A system as claimed in Claim 12, wherein the medical device is an artificial ventilator.

14. A system as claimed in Claim 12, wherein the medical device is a cardiopulmonary bypass oxygenator.

15. A system as claimed in Claim 14, comprising both a cardiopulmonary bypass oxygenator and an artificial ventilator selectively connectable to the said medical device supply circuit.

16. A method of providing a medical device with a medical gas mixture comprising at least two components, said method comprising:-

recirculating the medical gas mixture in a main circuit having a higher pressure section maintained at constant pressure in series with a lower pressure section;

withdrawing a portion of the medical gas mixture from the higher pressure section and feeding said portion to the medical device;

removing contaminant(s) from the spent gas mixture from the medical device and returning the decontaminated spent gas to lower pressure section;

replenishing components in the medical gas mixture by addition of feed gases to maintain the recirculating medical gas composition constant; and

varying the volume of the main gas circuit to maintain the gas flow therein.

17. A method as claimed in Claim 15, wherein the method comprises operating a medical device system as defined in any one of Claims 12 to 15.

18. A method as claimed in Claim 17, wherein medical gas mixture consists of oxygen and xenon.

19. A method as claimed in Claim 18, wherein the first feed gas is oxygen and the second feed gas is a mixture of xenon and oxygen.

20. A method as claimed in Claim 17, wherein medical gas mixture consists of oxygen, xenon and nitrogen.

21. A method as claimed in Claim 20, wherein the first feed gas is oxygen, the second feed gas is a mixture of xenon and oxygen and the third feed gas is air.

22. A method as claimed in Claim 20, wherein the first feed gas is oxygen, the second feed gas is xenon and the third feed gas is nitrogen and the concentrations of oxygen and nitrogen are measured.

23. A method as claimed in Claim 20, wherein the first feed gas is oxygen, the second feed gas is xenon and the third feed gas is nitrogen and the concentrations of oxygen and xenon are measured.

24. A method for the extracorporeal treatment of blood by contacting blood with a recirculating medical gas mixture in a device provided with the medical gas mixture using a method defined in any one of Claims 16 to 23.